LOW INTENSITY BURN PRIOR TO BEDDING AND PLANTING SLASH PINE IS OF LITTLE VALUE[1/]

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Abstract.--On a Lower Coastal Plain site in Georgia, unburned plots and plots that had received a low-intensity broadcast burn were drum chopped, bedded, and machine planted to slash pine *(Pinus elliottii* Engelm. var. *elliottii)*. Measurements through 6 years after planting suggested that burning had little or no effect on survival, fusiform rust infection, overtopping, or growth of pine seedlings. Independent of the effects of burning, pine growth was significantly reduced by early, transitory overtopping and by proximity to bluestem grasses or bitter gallberry.

INTRODUCTION

For many decades, foresters have burned clearcut southern pine sites to prepare them for pine planting. These prescribed fires reduced the wildfire hazard, facilitated planting, and increased survival and growth of the pine seedlings. During the last few decades, even better performance of pines has been achieved by following the burn with various types and intensities of mechanical site preparation. We question the benefits of such burning when conditions preclude a hot fire and when the area is also scheduled for intensive mechanical treatment.

The study described here was designed to measure the benefits, if any, of a light intensity fire prior to bedding to prepare a site for planting of slash pines *(Pinus elliottii* Engelm. var. *elliottii)*. Observations on the effects of competing vegetation on seedling growth are also reported.

The study area is on the Lower Coastal Plain in Echols County, Georgia, on land leased by St. Regis Paper Company of Jacksonville, Florida. Soil is a poorly drained Leon fine sand. A natural stand of slash pine was harvested from the area 2 years before it was site prepared.

Observations and measurements taken on thirty 1/4-milacre plots just prior to preparation revealed that the vegetative cover of the site consisted mostly of bitter gallberry, bluestem grasses, saw palmetto, blueberry bushes, fetter bushes, and threeawn and dropseed grasses.[3/] The ovendry weight of vegetation, or standing fuel, was estimated to be 4.1 tons per acre.

During the 6 years between clearcutting and site preparation, most of the logging debris, and all of the pine-needle litter, had decomposed. The litter layer, therefore, was composed mostly of fallen leaves from shrubs and dead herbaceous material. It was estimated to weigh less than 1/2 ton per acre.

METHODS

Site Preparation and Planting

St. Regis scheduled the site for broadcast burning in August 1971, to be followed by scarification with an offset, tandem-drum chopper and the raising of 6-inch-high beds on 12-foot centers with a bedder-packer. After allowing several weeks for soil settling, 1-year-old nursery seedlings of slash pine were to be planted 6 feet apart along the beds with a Lowther drag-type planting machine, in which a planter rides facing forward and inserts seedlings into the planting slit.

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3/Scientific names of competing plants are provided in table 1.

To accomodate our study, four 1/2-acre blocks were established on the study site before burning, and half of each block was randomly chosen to remain as an unburned but chopped and bedded plot.

Firelines were plowed in August 1971 to protect four 1/4-acre plots from the broadcast burn that would be set as soon as conditions were favorable. The next several months, however, illustrated one of the problems that prompted us to establish this study: rain began falling whenever fuel moisture conditions indicated that the site would soon be dry enough to burn.

The area finally dried out enough to carry a fire in early November. The ensuing fire traversed between 60 and 81 percent of the four burned plots, topkilling the grasses, forbs, and smaller shrubs. We estimated fire intensity to be less than 50 BTU's per second per foot of fire line. All unburned portions of the burned plots were mapped so that after planting these portions could be excluded from the 100-tree measurement plots. The entire study area was chopped in January, bedded in February, and planted in March of 1972.

Measurements

After planting, the distances between planting positions were measured to determine if burning facilitated construction of beds and thus permitted more uniform planting spacing. Also, each measurement seedling was judged to be either well planted, deep planted, shallow planted, or unplanted (released from the planting machine at the proper distance, but not actually planted).

Seedling heights and diameters and incidence of cankers (caused by *Cronartium fusiforme* Hedgc. & Hunt) were recorded periodically through 6 years after planting.

Changes in understory fuel weight and understory plant species were documented on two 1/4-milacre plots located in each treatment plot. Percent crown cover of the various understory species was estimated using a light table, a dot grid, and stereo-pairs of 35-mm color transparencies. These transparencies had been taken downward from a portable camera support over permanent quadrats as described by Pierce and Eddleman (1970).

Competition to the pines, including overtopping, was periodically evaluated by recording the species of plant within 1 foot of each surviving measurement pine that appeared to be offering the most competition to that pine.

Statistical Analyses

Analyses of variance for a completely randomized design were used to compare differences between the burned and unburned treatments. Factors examined included quality of planting; height, diameter and survival of the pines; incidence of fusiform cankers; percent of pines overtopped by competing vegetation; weight of understory fuels; and frequencies of various understory species.

Data from the burned and unburned plots were combined for analysis of effects of overtopping species on height and diameter of pines. Again, differences were evaluated by analysis of variance.

Differences between percent crown coverage of burned and unburned understories were analyzed by a t-test.

RESULTS AND DISCUSSION

Seedling Performance

Seedling spacing along the planting rows averaged 5-1/2 feet for both the burned and unburned plots, but the standard deviation in spacing was actually greater for the burned plots. Burned plots contained more well planted seedlings than the unburned plots (92 versus 88 percent), but the difference was not statistically significant. Thus, burning before mechanical preparation resulted in little, if any, improvement in planting.

A comparison based upon all measurement positions 6 years after planting showed the following:

	Burned plots	Unburned plots	Significant level of difference
6th Year:			
percent survival	89	83	NS
height in feet	15.6	16.6	NS
DBH in inches	2.65	2.85	NS

These differences are not sufficient to judge one treatment better than the other.

By 6 years after planting, 5 trees on the unburned plots had been killed by fusiform rust cankers and 18 survivors had stem cankers, whereas no trees had been killed by fusiform on the burned plots and 16 survivors had stem cankers. The differences, however, were not statistically significant.

Understory Development

Immediately after chopping and bedding, both the burned and unburned plots were essentially devoid of standing vegetation. Recovery of vegetation appeared to be faster on the unburned plots, but differences between treatments in height and density of competing vegetation and in numbers of pines overtopped were not statistically significant.

Bitter gallberry bushes and bluestem grasses inated the understory before preparation. They ll dominated it after preparation (table 1). palmetto, blueberry bushes, fetter bushes, and eeawn and dropseed grasses were less prevalent er site preparation than before. The other cies listed in table 1 were encountered too requently to judge the effect of site prepara- n upon their numbers. In general, however, understory on both the burned and unburned ts three years after preparation looked much it had before preparation.

No significant differences between burned and unburned plots were found in the frequencies of bitter gallberry, or bluestem grasses, or threeawn plus dropseed grasses or panic plus paspalum grasses. Frequencies of the other species listed in table 1 could not be statistically compared because they were absent from one or more plots.

Woody plant competition to pines on the burned plots, initially low, increased to almost that on the unburned plots by 6 years after planting (fig. 1). At no measurement, however, was the difference significant.

le 1.--Species within 1 foot of the surviving pines that appeared to be offering the most competition to individual pines, expressed as percentages of planting positions with surviving pines.1/

Species or Species Groups	One year after planting		Three years after planting		Six years after planting	
	Burned	Unburned	Burned	Unburned	Burned	Unburned
	- - - - - - - - - - percentages - - - - - - - - - -					
DY PLANTS						
itter gallberry *(Ilex glabra* (L) Gray)	24.3	28.7	53.0	56.3	72.4	71.8
outhern waxmyrtle *(Myrica cerifera* L. var. *cerifera)*	0.3	1.4	0.9	2.0	2.9	4.8
etter bushes *(Lyonia* spp. Nuttall)	1.5	1.3	1.4	1.4	0.7	0.0
edbay *(Persea borbonia* (L) Sprengel)	0.3	0.5	0.6	1.0	0.6	2.4
weet pepperbush *(Clethra alnifolia* L.)	2.8	2.1	0.3	0.3	0.3	0.0
hokeberry *(Sorbus arbutifolia* (L) Heynhold)	0.9	4.9	0.0	1.3	0.0	0.0
aw palmetto *(Serenoa repens* (Bartram) Small)	0.4	0.8	1.5	2.1	0.6	1.5
weet gallberry *(Ilex coriacea* (Pursh) Chapman)	0.0	0.3	0.0	1.0	0.0	0.0
lueberries *(Vaccinium* spp. L.)	3.1	5.9	0.6	0.0	0.0	0.0
ed maple *(Acer rubrum* L.)	0.3	0.0	0.3	0.0	0.3	0.4
rape *(Vitis* spp. L.)	0.0	0.0	0.0	0.0	0.0	0.3
reenbrier *(Smilax* spp. L.)	0.5	0.0	0.0	0.0	0.0	0.0
BACEOUS PLANTS						
luestem grasses *(Andropogon* spp. L.)	17.0	26.4	38.4	33.1	22.2	18.9
hreeawn and dropseed grasses *(Aristida* spp. L. and *Sporobolus* spp. R. Brown)	5.6	3.1	0.3	0.3	0.0	0.0
anic and paspalum grasses *(Panicum* spp. L. and *Paspalum* spp. L.)	29.2	10.2	0.0	0.0	0.0	0.0
ther grasses and grasslikes (Poaceae, Cyperaceae, and Juncaceae)	8.8	7.1	2.6	1.2	0.0	0.0
omposites (Asteraceae)	3.3	1.6	0.0	0.0	0.0	0.0
edroot *(Lachnanthes caroliniana* (Lam.) Dandy)	0.3	2.3	0.0	0.0	0.0	0.0
erns	0.0	0.7	0.0	0.0	0.0	0.0
nidentified Herbaceous species	0.8	1.4	0.0	0.0	0.0	0.0
COMPETING PLANTS WITHIN 1 FOOT OF PINES	0.6	1.3	0.0	0.0	0.0	0.0
AL PERCENT	100.0	100.0	99.9	100.0	100.0	100.1

1/For example, the first numerical entry indicates that 24.3 percent of the pines surviving on the ned plots 1 year after planting appeared to be receiving more competition from bitter gallberry than m any other species.

The measurement of crown coverage using vertical stereophotographs indicates that vegetative recolonization of the study site was rapid, with more than 90 percent of the site covered with vegetation 2 years after site preparation. Percent cover of herbs peaked at 2 years, then decreased during the next year as coverage of woody plants increased. Neither the woody nor the herbaceous coverage differed significantly between the burned and unburned plots. Graphic presentation of this coverage (fig. 2) suggests, however, as did the competition data in figure 1, that burning plus mechanical preparation resulted in more effective initial control of woody plants than did mechanical preparation alone.

Of the 436 well-planted pines not overtopped by other vegetation 1 year after planting, only 2 subsequently became overtopped (temporarily), and only 6 died between the first and sixth years after planting. Of the 158 well-planted pines overtopped at 1 year, only 3 were still overtopped at 3 years, 2 were overtopped at 4 years, 1 was overtopped at 6 years, and only 2 died between the first and sixth years. Despite its transitory nature, the overtopping, or something associated with it, reduced height and diameter growth through 6 years after planting:

Years since planting	Pines overtopped at 1 year	Pines not overtopped at 1 year	Significant level of difference
	- - - - - - height in feet - - - - - -		
0	0.7	0.7	NS
1	1.0	1.1	0.005
4	8.0	9.0	0.005
6	15.0	16.6	0.05
	- - - - - - DBH in inches - - - - - -		
6	2.50	2.85	0.05

The most meaningful of the competition measurements appeared to be the one made 6 years after planting among the well-planted surviving pines that were not infected with stem canker. In that measurement, 73 percent of the pines were judged to be receiving their major competition from bitter gallberry, 19 percent from bluestem grasses, and the remaining 8 percent from saw palmetto, fetter bush, waxmyrtle, redbay, red maple, or grape vine. Average height and diameter of the pines varied with the species of the competitor:

Competitor	Pine Height	Pine DBH
	feet	inches
Bluestems	15.3	2.6
Gallberry	16.4	2.8
All others	17.3	3.1

Pines competing with the bluestems (chiefly *Andropogon virginicus* L. and *A. capillipes* Nash) averaged significantly shorter (0.05 level) and smaller in diameter (0.025 level) than pines competing with those species referred to collectively as "all others". The growth retarding effect of the bluestems upon slash pine may be less of a competition effect than an allelopathic effect, considering that Priester and Pennington (1978) found that water extracts from the shoots of *A. virginicus* slowed the height growth of loblolly pine (*Pinus taeda* L.) seedlings.

Pines competing with bitter gallberry were significantly smaller in diameter (0.025 level) but not significantly shorter than pines competing with the "all others" category. Pines competing with bitter gallberry did not differ significantly in height or diameter from pines competing with bluestems.

SUMMARY AND CONCLUSIONS

Growth of slash pine seedlings was signficantly reduced by proximity to bluestem grasses or to bitter gallberry, or by temporary overtopping by any competing plants. This information may be of more direct use to the forester researcher than to the forest manager.

Of more immediate use to the forest manager are the results indicating that prescribed fire before mechanical preparation may not be necessary. Effects of the low intensity fire before chopping, bedding, and planting had neither practical nor statistical significance. A fire of higher intensity might have produced differences of statistical and economic significance. The fact remains, however, that without any prescarification fire, slash pine averaged 16 feet tall and 83 percent survival 6 years after planting. Under the conditions of the study, an entirely adequate plantation was established without burning!

Because most of the logging debris had decomposed and the mechanical treatments had adequately controlled the competition, burning was not cost effective. Prescarification burning probably is equally unnecessary on sites where most of the combustible material has been removed by whole-tree harvesting. Even on sites with more debris, a prolonged wait for good burning conditions could result in the cost of burning outweighing its benefits. If such a wait seems likely, and a mechanical treatment that will allow acceptable stand establishment at an acceptable cost is available, burning should probably be foregone.

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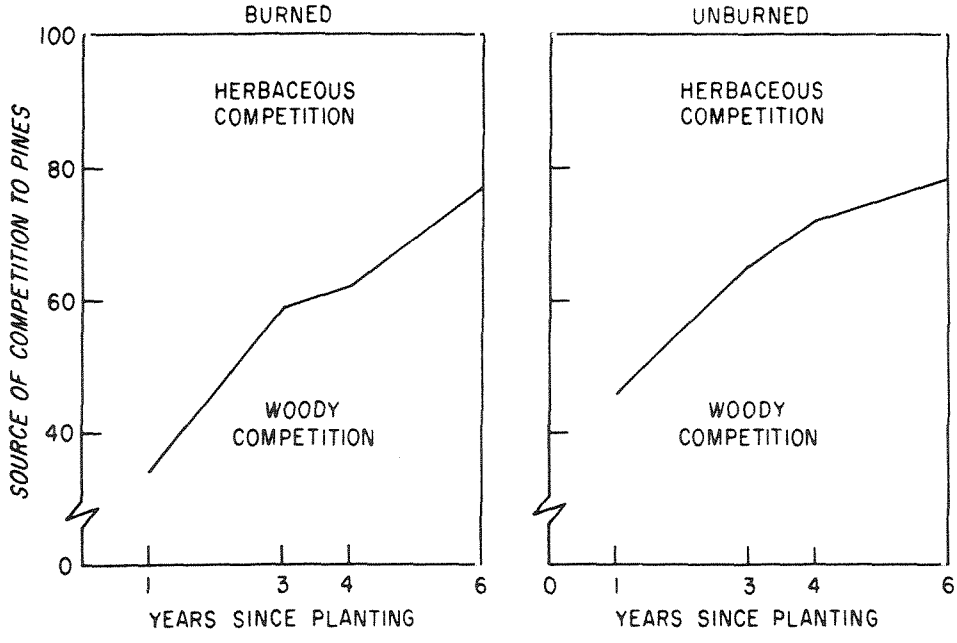

Figure 1.--Trend toward woody competition with time since site preparation.

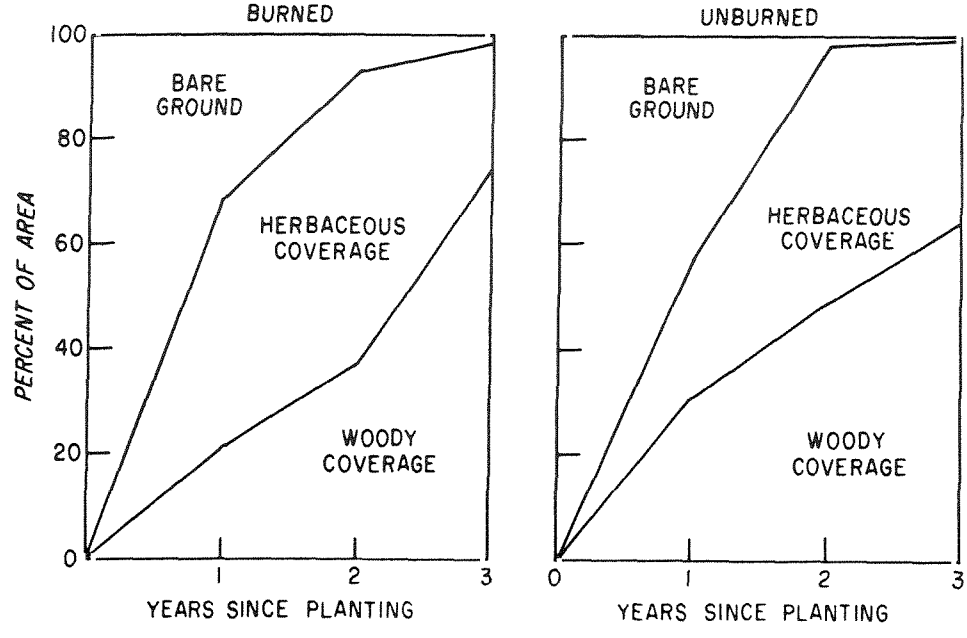

Figure 2.--Trend toward woody understory coverage with time since site preparation.

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